G1:  V = \{S, 0, 1\}, T = \{0, 1\}, P = \{S \rightarrow 0S, S \rightarrow S1, S \rightarrow \lambda\}

G2:  V = \{S, A, 0, 1\}, T = \{0, 1\}, P = \{S \rightarrow 0S, S \rightarrow 1A, A \rightarrow 1A, A \rightarrow 1 S \rightarrow \lambda\}

1. Use the set of productions to show that each of these sentences is a valid sentence.
   a) the happy hare runs
   b) the sleepy tortoise runs quickly
   c) the tortoise passes the hare
   d) the sleepy hare passes the happy tortoise

3. Show that the hare runs the sleepy tortoise is not a valid sentence.

7. a) Construct a derivation of 0^21^4 using the grammar $G_1$ in Example 6.
   b) Construct a derivation of 0^21^4 using the grammar $G_2$ in Example 6.
11. Find a phrase-structure grammar for each of these languages.
   a) the set of all bit strings containing an even number of 0s and no 1s
   b) the set of all bit strings made up of a 1 followed by an odd number of 0s
   c) the set of all bit strings containing an even number of 0s and an even number of 1s
   d) the set of all strings containing 10 or more 0s and no 1s
   e) the set of all strings containing more 0s than 1s
   f) the set of all strings containing an equal number of 0s and 1s
   g) the set of all strings containing an unequal number of 0s and 1s

3. Given the finite-state machine shown in Example 2, determine the output for each of these input strings.
   a) 0111     b) 11011011     c) 01010101010

<table>
<thead>
<tr>
<th>State</th>
<th>f</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>s₀</td>
<td>s₁</td>
<td>s₀</td>
</tr>
<tr>
<td>s₁</td>
<td>s₃</td>
<td>s₀</td>
</tr>
<tr>
<td>s₂</td>
<td>s₁</td>
<td>s₂</td>
</tr>
<tr>
<td>s₃</td>
<td>s₂</td>
<td>s₁</td>
</tr>
</tbody>
</table>

7. Construct a finite-state machine that delays an input string two bits, giving 00 as the first two bits of output.
8. Construct a finite-state machine that changes every other bit, starting with the second bit, of an input string, and leaves the other bits unchanged.
9. Construct a finite-state machine for the log on procedure for a computer, where the user logs in by entering a user identification number, which is considered to be a single input, and then a password, which is considered to be a single input. If the password is incorrect, the user is asked for the user identification number again.